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THE STUDY OF ANTIBACTERIAL ACTIVITY OF ZINC OXIDE NANOPARTICLES SYNTHESIZED USING CYNODON DACTYLON

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ABSTRACT

Nanoparticles are a type of materials which are different from bulk material due to their surface to volume ratio. In this study Zinc oxide Nanoparticles are synthesized using Cynodon dactylon leaf extract and the effectiveness of biologically synthesized ZnO NP as antibacterial agent also revealed. Zinc oxide nanoparticles are quickly formulated by Biological approach because of the utilization of leaf extract components as reducing, Stabilizing and capping agents. Amalgamated Zinc oxide nanoparticles are characterized using FTIR (Fourier Transform Infrared Spectroscopy), SEM (Scanning Electron Microscope), UV Visible Spectrophotometer, Particle Size Analyzer. The characterization technique ensures their optical and morphological property. The Zinc oxide nanoparticles exhibit dose dependent antibacterial activity against gram positive Bacillus sp and gram negative Escherichia coli. The observed zone of inhibition is an evidence to demonstrate biologically synthesized zinc oxide nanoparticles role in Nanomedicine research.

KEYWORDS: Cynodon dactylon, Zinc Oxide Nanoparticles, SEM, FTIR & Antibacterial Activity

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Original Article

INTRODUCTION

Nanoparticle has a major responsibility in the development of nanotechnology. Chemical and Physical approaches are employed to form nanoparticles but Biological approach is an Eco friendly, cost effective method. The property of nanoparticles majorly depends on its synthesizing procedure. Preparation of ZnO NP using Cynodon dactylon leaves known as Bermuda grass is a bottom up approach. Here the phytochemical such as flavanoids, alkaloids, glycosides, saponins, terpenoides, tannins, resins, phytosterols, proteins and volatile oils are involved in oxidation and reduction process of solution that consist leaf extract and zinc acetate dihydrate as precursor. The Cynodon dactylon leaves are well known for their anti diabetic, anti allergic, anti inflammatory, antipyretic, anti parasitic property(Ali Esmail,2016). This Bermuda grass leaves also exhibit better wound healing property (Anand Kumar,2013). In previous study the anti fungal activity of silver nanoparticles synthesized using Cynodon dactylon has been investigated(Arvind Singh,2017). Bactericidal effect of Bermuda grass exhibits their inhibition against human pathogenic bacteria (Bishnu,P,2015). This is an attempt to examine the anti bacterial activity of ZnO NP synthesized using the leaves of Cynodon dactylon. Among the variety of metal nanoparticles zinc oxide nanoparticles demand in market increases due to their catalytic, anti corrosion, anti bacterial, antifungal and optical property. Zinc oxide nanoparticles are widely applied in food packaging, sensors, Cosmetics, environmental protection, electronics, Biological labeling, Nanomedicine (Pragati,2018), Drug and gene delivery. The antibacterial activity of Zinc oxide nanoparticles responsible to treat skin rashes and etching in skin. So it applied in cosmetics to form sunscreen lotion.

PREPARATION OF LEAF EXTRACT

Cynodon Dactylon medicinally important leaves collected from Ammayarpatti during the month of January to March. The collected leaves were washed with normal tap water. After air drying 2.5g of the leaves were cut and soaked in 50ml of distilled water and boiled at 50℃ for 20mins. The filtrate was collected using filter paper.

SYNTHESIS OF ZNO NANOPARTICLES

1mM Zinc acetate dihydrate ($C_4H_6O_4Zn \cdot 2H_2O$) was dissolved in 50ml of deionized water and kept in magnetic stirrer at 20℃ for 1hr.2g of 20ml sodium hydroxide solution was added to that solution drop wise at the same time 25ml of plant sample also introduced which leads to the color change of that solution. After 1hr of incubation time, again kept in magnetic stirrer at the same temperature for 3 hr. The solution was kept in hot plate at 80℃ for 2hr to produce the powder form of nanoparticles.

RESULTS AND DISCUSSIONS

Characterization of Zinc Oxide Nanoparticles

Optical properties of Zinc Oxide nanoparticles were characterized based on the UV absorption spectrum between the ranges of 200-600nm. UV visible spectrophotometer (Mark: LABMAN, Model No: LMSP – UV1000B) scrutinized the absorbance of green synthesized zinc oxide nanoparticles at different wavelength based on their optical property. The peak values are obtained at 500nm and 200nm wavelength. 200nm exhibit the high peak at 0.11absorbance value. This optical property of the ZnO nanoparticles suitable for applied as a pigment in paints, UV filter in product for sun protection and for the production of LEDs and TFTs (Pragati Jamdagni,2018).

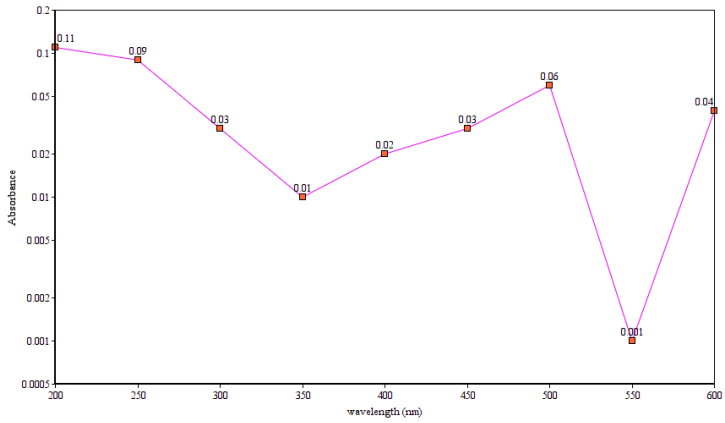

Figure 1: UV Visible Spectrum

Particle Size Analyzer also helpful to know the size distribution. The size of the synthesized Zinc oxide Nanoparticle was confirmed by forming spectrum between the particle diameter and amount of the particle. These results show the particle size is 70± 8nm that variations occur due to the use of dispersion solvent.

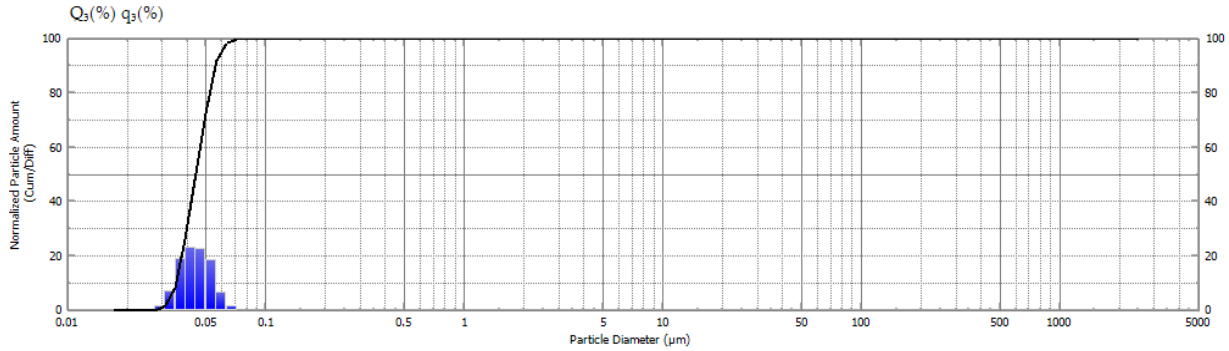

Figure 2: Particle Size Analyzer Spectrum

FT-IR (Fourier Transform Infrared Spectroscopy) examined the sample based on their Transmittance effect with respect to their Frequency. FT-IR result investigated in Shimadzu 8400S model. The broad band obtained a 14471/cm and the sharp band obtained at 621.041/cm. The FTIR spectra resulted in various peaks at 2359.74, 1643.24, 1447.48, 1206.39, 1182.28, 1110.92, 992.31, 879.48, 778.22, 692.40, 621.04 and 585.361/cm. Bends and stretches also observed in this result. O-H band present in 3451.38 1/cm whereas C-H at 3000.07 1/cm. C-O and C-C are occur at below 1500 1/cm.

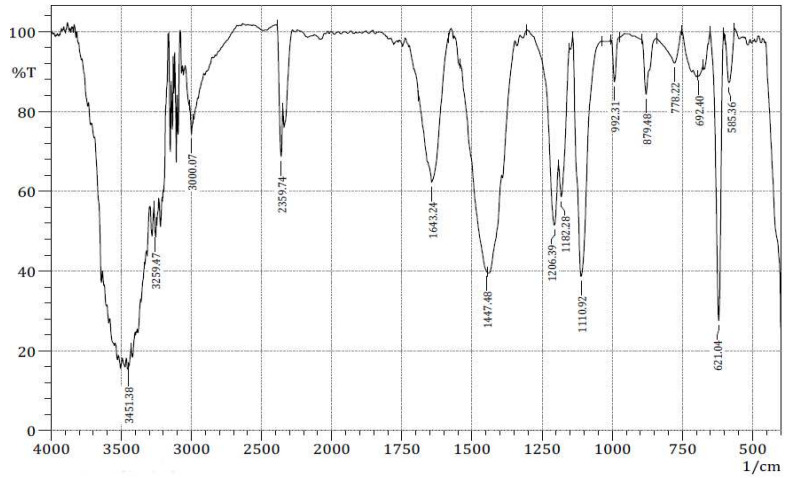

Figure 3: FT-IR Spectrum

Morphological characteristics of the biosynthesized nanoparticles are identified by SEM (Scanning Electron Microscope (VEGA 3 TESCAN model)) images. Smooth surface observed in this result in the range of $1\mu m$-$10\mu m$. These images showed the agglomerated and non agglomerated regions of those nanoparticles at various scale level by the application of electron after sputtering. The shapes of the nanoparticles are in spherical and rod. Due to optical, electrical and mechanical potentials zinc oxide nanoparticles are performed their role in food industry, chemical industry, electrical industry and agricultural society.

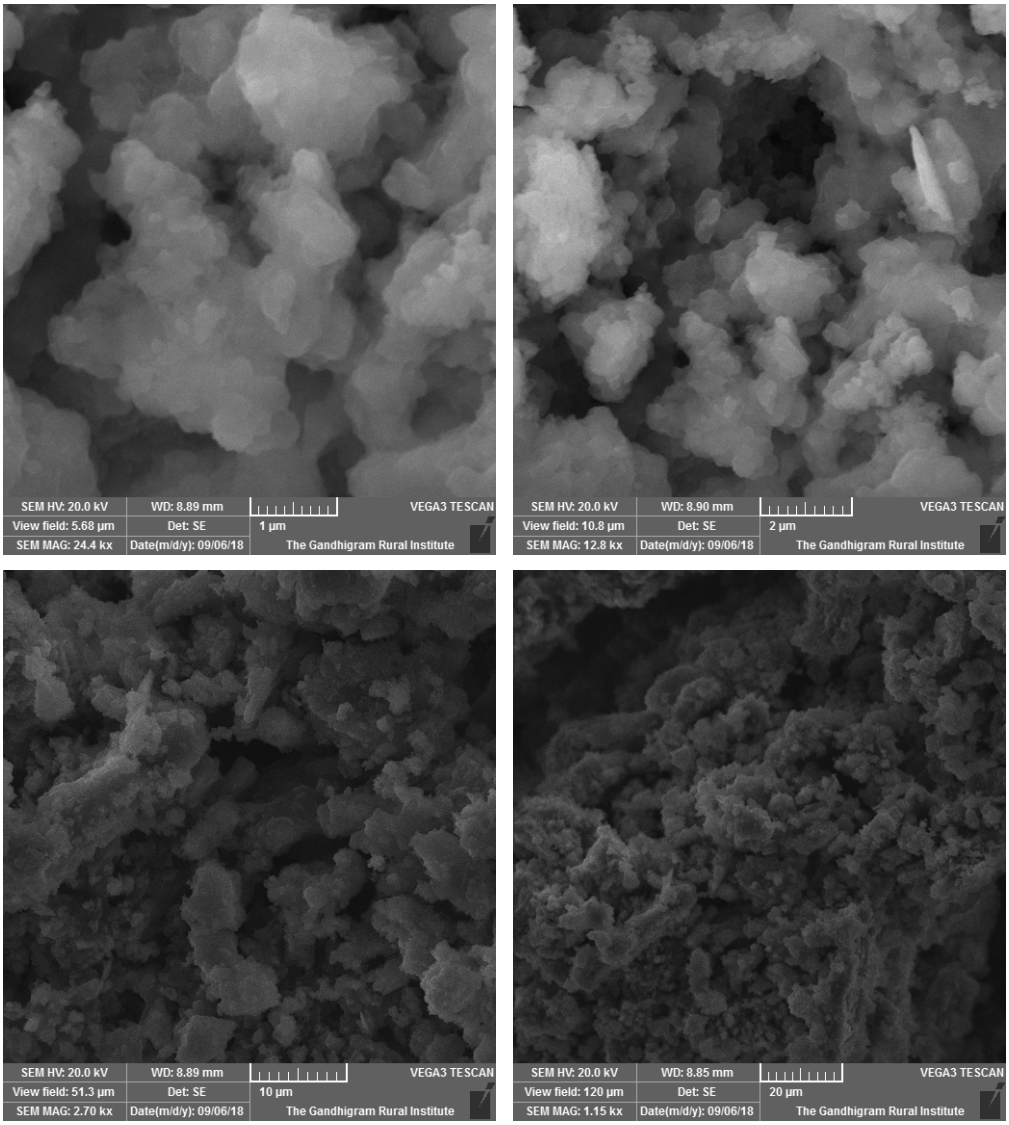

Figure 4: SEM Images for Zinc Oxide Nanoparticle Synthesized using Cynodon Dactylon

Antibacterial Activity

Antibacterial activity of green synthesized Zinc oxide nanoparticles was performed against *E.coli* gram negative bacteria and gram positive bacteria *Bacillus sp* by Disk diffusion method. The zone of inhibition was measured at various concentrations such as 10mg/ml, 20mg/ml and 30 mg/ml in both bacteria. The zone of inhibition shows the bactericidal activity of zinc oxide nanoparticles synthesized using *Cynodon dactylon* against *E.Coli* and *Bacillus sp.* The maximum zone against those specific bacteria was observed at 30mg/ml. The diameter of zone of inhibition was surveyed in cm.

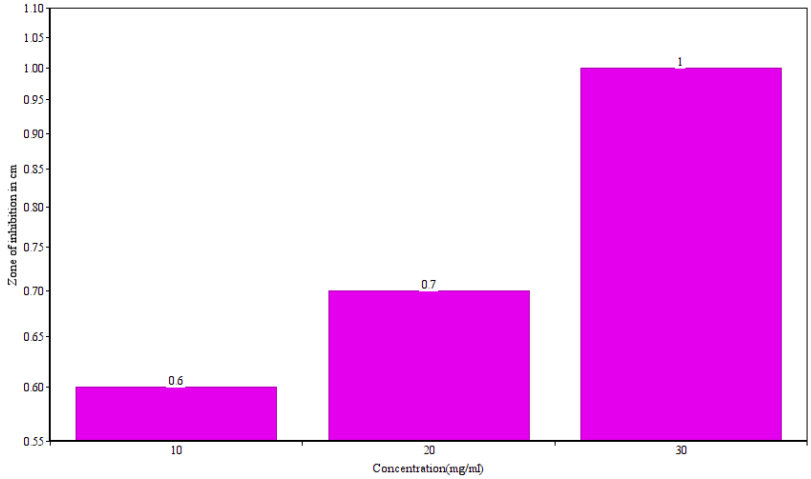

Figure 5: Antibacterial Activity of Green Synthesized Zinc Oxide Nanoparticles against Gram Positive Bacillus sp

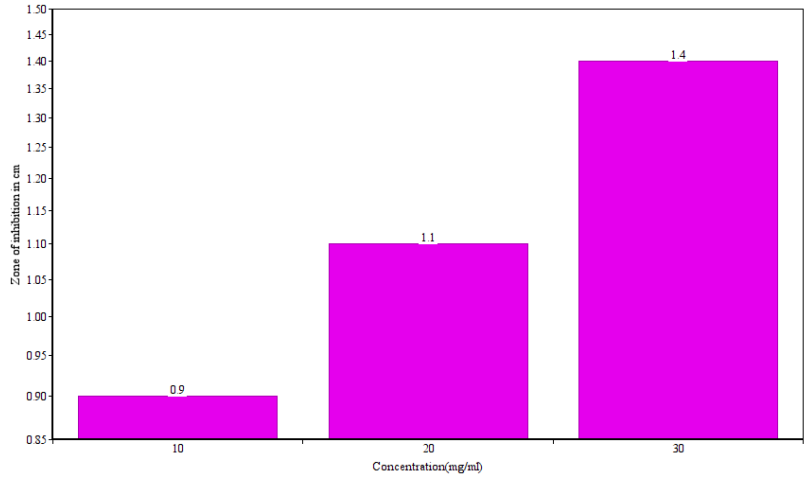

Figure 6: Antibacterial Activity of Green Synthesized Zinc Oxide Nanoparticles against Gram Negative E.Coli

CONCLUSIONS

The accomplishment of this study revealed the anti bacterial activity of Zinc oxide nanoparticles against *E.coli* and *Bacillus sp* at various concentrations. The generated nanoparticles possess plant protein and phytochemical. The particle size analyzer result shows 70± 8nm as the size of biologically synthesized zinc oxide nanoparticles. The occurrences of band in the synthesized nanoparticles are obtained by FTIR spectrum in terms of transmittance and frequency. UV visible spectrum shows a maximum peak at 200nm. The SEM image exhibits the shape at various scale levels. The result declared that the diameter of the zone of inhibition increased with increase in concentration.

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